REFINING PREDICTIONS OF IBERIAN PLANT DISTRIBUTION:

Lessons from *Pinus nigra* & *P. sylvestris* palaeoecological-based habitat suitability models

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INTRODUCTION

In recent years numerous habitat suitability models (HSM) have been developed to assess the impact of climate change on plant and ecosystem distribution under different climate change scenarios.

Yet, as the output of the different methods produces different distribution areas, developing validation tools are strongly needed to reduce uncertainties in model prediction, refine model performance and hence increase the predictive ability of the HSMs.

We propose a palaeo-based method to increase the robustness of the HSM by analyzing the mismatches between the palaeoecological information and the projections of the HSMs.

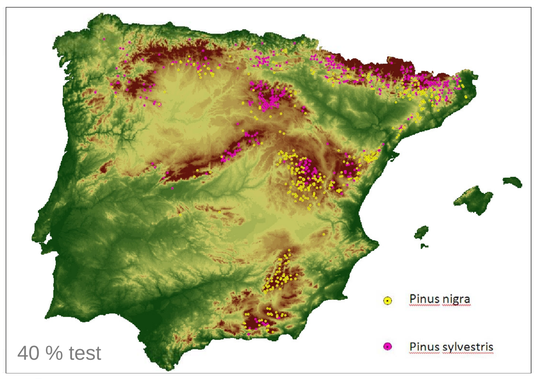
PRESENT WORK

(1) Investigation of causal relationships between environmental variables and presence of *Pinus sylvestris* L. and *Pinus nigra* Arn.

(2) Develop of present predictions through the MaxEnt model

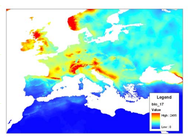
(3) Digitalization of available macroremain and palynological studies for the Iberian Peninsula for 6000 and the Lateglacial.

THE HABITAT SUITABILITY MODEL

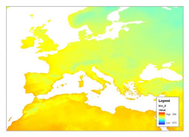


Current presence data
[1 km grid – Spanish National Forest Inventory]

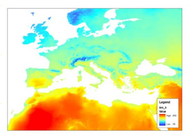
Environmental data
[http://www.worldclim.org]



BIO 17: Precipitation of Driest Quarter



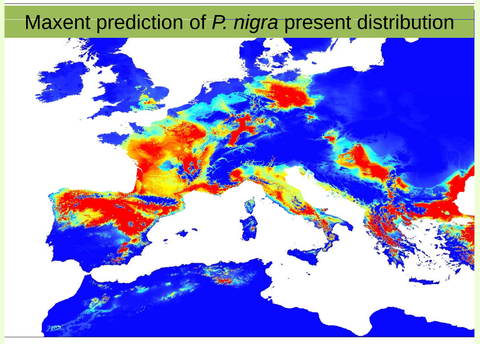
BIO 6: Minimum Temperature of Coldest Month



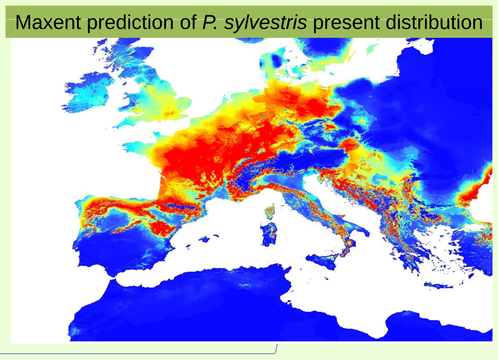
BIO 5: Maximum T Warmest Month

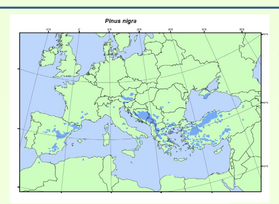
- ✓Maxent is a method for modelling geographic distributions of with presence-only data (Philips et al., 2006).
- ✓The occurrence localities (presence data) of the species (*P.nigra* and *P.sylvestris*) are obtained from the (a) 3rdSpanish Forest Inventory and the (b) European Forest Condition Monitoring Parcels (Level I).
- ✓(a) 60% training data [40% kept for test]; (b) 90% training [10% test]
- ✓environmental variables from the Worldclim database and Digital Spanish Climatic Atlas.

Maxent prediction of *P. nigra* present distribution

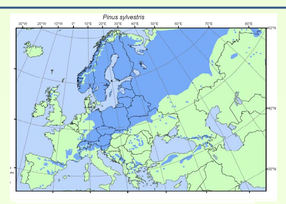


Maxent prediction of *P. sylvestris* present distribution





P. nigra distribution map (Euforgen, 2009)



P. sylvestris distribution map (Euforgen, 2009)

ONGOING WORK

- ✓ Selection of environmental variables (Spatial Analysis with R)
- ✓ Generation of HSM with different environmental variables
- ✓ Biomization of Iberian palaeo-data (Adecuating PFT to the Iberian Peninsula)
- ✓ Fixing δ_j and θ_j *values*

HYPOTHESIS:

- ➢Projections of the fundamental niche ≥ realized niche (persistence of species constrained by hard barriers, biotic interactions, dispersal ability…)
- ➢Ecological requirements of species stable through time

THE PROJECT

Presence data (Iberian Peninsula)

MaxEnt

Environmental data

Multiple HSM present

Selection

Validation: Present European distribution maps

Various **HSM present**

Environmental past conditions

Validation: Palaeoecological biomized data

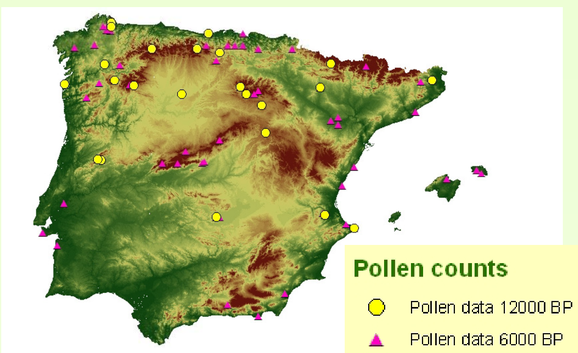
Best fit

HSM 6 BP, 21 BP

HSM present

THE PALAEOECOLOGICAL VALIDATION

- ✓Collect macroremain and palynological studies: European Pollen database; Paleodiversitas, Senscom Projects (Min. Ciencia e Innovación, Spain)
- ✓Digitalize 1 kyr step palaeoecological information
- ✓Assign each spatial and temporal point (*k*) to Plan Functional Types (PFT) (Allue, 1990; Elenga 2000)
- ✓Analize the mismatches between the palaeoecological information and the projections of the HSMs



ASSIGNING PFT TOEACH POINT

➢ Calculate and Affinity index (A_i) to all $PFT_{(i)}$:

$$A_{ik} = \sum_j \delta_{ij} \sqrt{\{\max [0, (p_{jk} - \theta_j)]\}}$$

- δ_j = presence/absence value of taxon *j*
- P_{jk} = relative pollen percentage
- θ_j = threshold pollen percentage

RESULTS & DISCUSSION

➢ Performed HSM ≠ present European distributions

- not all the environmental variability registered
- realized niche triggered by competition and anthropogenic forest clearing
- consideration of isolated presences as refugial areas

➢ Biomization

- Few sites with data >15000 yrs BP
- Work with the Younger Dryas (11.7 -12.9 kyr BP)
- PFT, δ_j, θ_j are not established for the specific case of the Iberian P.